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$$=L[1+\frac{W\sin\varphi}{2M}]. \quad \therefore \frac{WL\sin\varphi}{2M} \text{ is the elongation.}$$

Also solved by the Proposer.

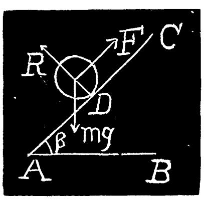
201. Proposed by G. B. M. ZERR, Ph. D., Parsons, W. Va.

ABC is an inclined plane, perfectly rough, length $AC=l$. The time for a sphere to roll down when AB is base is to the time for a cylinder to roll down when BC is base as m is to n. Find AB and BC.

Solution by J. SCHEFFER, A. M., Kee Mar College, Hagerstown, Md.

Let O be the center of any rolling body of mass m; then the three forces that will act on it are its weight mg vertically downward, the resistance R on the inclined plane AC, and the friction F acting up the plane.

Denoting CD by s, we have therefore $m(\partial^2 s/dt^2)=mg\sin\beta-F$; and if we denote by θ the angular velocity, reducing the mass to the center O, we have $m\rho^2(\partial^2\theta/\partial t^2)=Fr$, r being equal to DO, and ρ radius of gyration. Since there is no sliding, the plane being perfectly rough, we have $s=r\theta$. Eliminating F, we have $\partial^2 s/dt^2=[r^2/(r^2+\rho^2)]g\sin\beta$, and integrating



$$s=\frac{r^2}{r^2+\rho^2}g\sin\beta\, t^2.$$

For the sphere $\rho^2=\frac{2}{5}r^2$, and for the cylinder $\rho^2=\frac{1}{2}r^2$; therefore, by the condition of the problem, for the sphere

$$l=\frac{r^2}{r^2+\frac{2}{5}r^2}g\,.\frac{BC}{l}t^2, \text{ whence } t^2=\frac{14l^2}{5g.\overline{BC}},$$

and for the cylinder, $l=\frac{r^2}{r^2+\frac{1}{2}r^2}g\,.\frac{AB}{l}t^2$, whence $t^2=\frac{3l^2}{g.\overline{AB}}$; $\therefore \frac{14}{5\overline{BC}}:\frac{3}{\overline{AB}}=m^2$

$:n^2$, and combining this with $\overline{AB}^2+\overline{CB}^2=l^2$, we get

$$AB=\frac{14n^2l}{\sqrt{(225m^4+196n^4)}},\quad CB=\frac{15m^2l}{\sqrt{(225m^4+196n^4)}}.$$

Also solved by J. Edward Sanders, and the Proposer.

AVERAGE AND PROBABILITY.

185. Proposed by R. D. CARMICHAEL, Anniston, Ala.

If a line l is divided into n parts by $n-1$ points taken at random on it, what is the mean value of the pth power of one of the parts taken at random?